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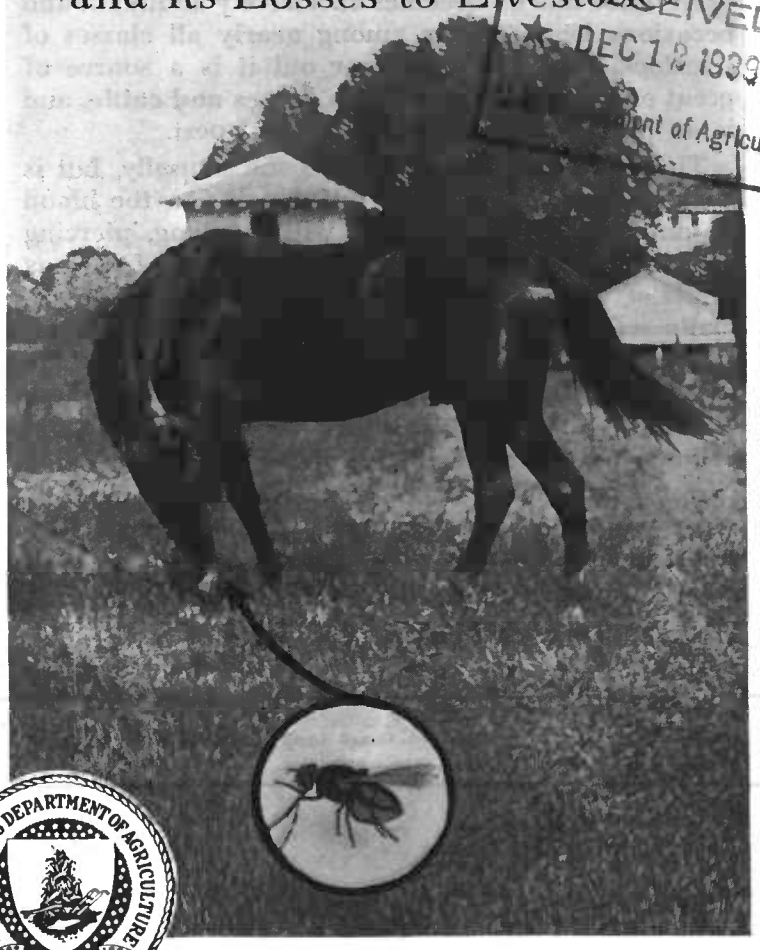
The STABLEFLY

How to Prevent Its Annoyance and Its Losses to Livestock



THE ACUTE PAIN produced by the insertion of the proboscis of the stablefly brings to any man a sudden realization that this biting insect is pointedly different from the housefly, or typhoid fly, even if until then his opinion had been that the two were identical.

At times this fly becomes excessively abundant and occasions heavy losses among nearly all classes of livestock. Year in and year out it is a source of great annoyance, especially to horses and cattle, and is an all-too-common and persistent pest.

The adult stablefly resembles the housefly, but is slightly broader and feeds principally on the blood of animals, which it draws with its long, piercing mouth parts. It breeds in accumulations of various kinds of vegetable matter and also in manure, especially when the latter is mixed with straw. When strawstacks become wet soon after threshing the flies breed in the fermenting straw, and it is these conditions that produce the severe outbreaks.

Spraying animals with repellents is not very satisfactory, but the numbers of stableflies can be kept down by caring properly for stable refuse and by stacking or otherwise disposing of the straw.

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THE STABLEFLY: HOW TO PREVENT ITS ANNOYANCE AND ITS LOSSES TO LIVESTOCK

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CONTENTS

A TORMENTING AND INJURIOUS PEST

THE STABLEFLY,[1] or stock fly, is one of the most important sources of annoyance to livestock throughout the United States. When present in small numbers it has no apparent injurious effect, but on frequent occasions conditions arise which permit its development in enormous numbers, and at such times the injury to all classes of livestock becomes marked.

In addition to being a source of annoyance to domestic animals, the stablefly, when present in large numbers, has a deleterious effect upon them owing to the quantity of blood drawn, and animals not infrequently are so reduced in vitality as to permit certain diseases to become acute and cause their death. In Africa and other parts of the world this fly is capable of transmitting certain serious maladies of horses and camels. In our country it probably plays a part in the dissemination of anthrax, and investigations indicate that the disease of horses known as swamp fever or infectious anemia is carried by it. Work thus far conducted indicates that the fly acts solely as a mechanical carrier, passing these diseases directly from one animal to another in biting.

In addition to its role as a livestock pest, the stablefly is important as an annoyer of man, and there is some indication that it is concerned, in part at least, with the transmission of certain diseases of man, most notable of which is infantile paralysis.

THE COMMON NAMES OF THE INSECT AND HOW IT MAY BE RECOGNIZED

"Stablefly" is not entirely satisfactory as a common name for this pest, as it is frequently abundant in open fields and along roadways and is not uncommonly encountered about the house. Nevertheless

[1] Known scientifically as *Stomoxys calcitrans* (L.).

it is found about stables more frequently than anywhere else. In certain localities such names as "stablefly," "stock fly," "dog fly," "wild fly," "straw fly," and "biting housefly" are applied to it.

As the last name suggests, this insect is frequently confused with the housefly.[2] The common housefly is not capable of biting, its mouth parts being soft and broad on the tip. On the other hand, the stablefly has mouth parts well fitted for piercing the skin of animals and sucking blood. The presence of such biting mouth parts, therefore, distinguishes it at once from the housefly. The tip of the beak can be seen protruding from beneath the front of the head when the fly is at rest. (See figs. 4 and 5.) The insect is usually slightly larger than the housefly and more robust. It usually alights upon an animal with the head directly upward, while another insect sometimes confused with it, the horn fly,[3] rests with its head downward, and the housefly may assume various positions and moves much more frequently. The horn fly is much smaller than the stablefly, the wings are widely spread at the tips, and it is usually present on cattle only, where it occurs in small swarms, moving from one part of the animal to another when disturbed.

DISTRIBUTION AND ABUNDANCE

The stablefly is very widely distributed throughout the world. In fact it seems to have followed man and his domestic animals to all quarters of the globe. It becomes more abundant, however, in the temperate regions, such as the United States and Argentina. In the United States it is found everywhere, but within the confines of this country its abundance varies considerably.

Serious annoyance to livestock is most common in the Central States from Texas to Canada, where grain is grown extensively. Reports indicate that it may be important occasionally in various other sections and is a more or less persistent pest in all irrigated regions.

From time to time exceedingly severe outbreaks of this insect occur. One of the worst of these took place in 1912. Injury in northern Texas and in Oklahoma during the late summer and early fall of that year was unprecedented. The pest was abnormally numerous throughout the entire grain belt, including the southern portions of central Canada. Since 1912 the insect has appeared in great numbers on several occasions, but these outbreaks have not been so widespread.

This fly appears not infrequently on warm days during the winter and early spring in the Southern States, but seldom does it become sufficiently abundant in any part of this country to cause annoyance before early summer. It nearly always increases in abundance and injury is most acute during August and September.

CHARACTER OF INJURY AND LOSSES

Practically all warm-blooded animals are attacked by the stablefly, but some domestic species are much freer from injury than others. This comparative freedom is due largely to protection afforded by the hair of the host or by some of its habits. Mules, horses, cattle, hogs,

[2] Known scientifically as *Musca domestica* L.
[3] Known scientifically as *Haematobia irritans* (L.).

dogs, cats, sheep, and goats are subject to attack in about the order named. The distress caused individual animals varies greatly with their temperament.

As has been indicated, this fly is of importance in a number of ways. There is little doubt that it is a potent factor in disease transmission, although actual proof of this has been secured in the case of a few diseases only.

Aside from conveying disease, this insect is of much importance on account of the worry produced by its bites. During severe outbreaks this is probably the most important cause of losses. In periods of great abundance all livestock are compelled to keep up a constant fight against flies from early morning until dark. At such times the flies are present not only around barns but in towns, cities, and open fields. Animals that are being worked in fields or on the streets and those kept in stables suffer alike. During severe outbreaks many horses and cattle become so weak that they give up the fight against the pest, and the flies swarm over them in countless numbers. In a few cases, where the animals are not promptly protected from attack, they succumb in a short time.

The loss of blood during severe outbreaks is an important consideration. When the fly is fully engorged, the abdomen is greatly distended, and it has been found that the blood extracted at one feeding is soon digested and the fly is ready for another meal. Thus animals continually exposed must serve to engorge thousands of individuals each day, each of the flies ingesting several drops of blood during a meal.

In the part of the United States where Texas fever occurs, in addition to the livestock actually killed by harassment and loss of blood, a considerable number of cattle are lost from Texas fever. In most of these animals, although the disease organisms are latent in the blood, no apparent injury would result under conditions favorable to livestock. Under the strain of continually fighting the flies and with the weakened condition brought about by the loss of blood, however, an acute form of Texas fever is induced. When animals begin to suffer from the fever they are less energetic in fighting the flies and consequently become the more ready victims.

During severe outbreaks the milk supply in fly-infested zones is much reduced. In the worst of these outbreaks dairymen find that the output of milk declines 40 to 60 percent and that in some cases cows are completely dried. For several months after the pest is abated the effects of the outbreak are apparent in lower milk production. Even in cows that freshen several months after an outbreak the effect on the yield of milk is said to be apparent.

During outbreaks all animals in the fly zone are reduced in flesh. In many cases cattle that had been fat enough for market are so lean that they cannot be sold advantageously. Horses and mules in many cases lose from 10 to 15 percent in weight. Some dairy herds that are usually shown at fairs suffer such marked injury that they are not fit to be exhibited.

In many cases the joints of both horses and cattle become so swollen and stiff from standing in water to avoid the flies that the animals can scarcely walk. Incessant stamping also injures their feet and joints.

Another source of loss to farmers is their inability to proceed with the usual farm plowing and other operations at the proper time. In many sections the flies annoy the horses so much that they cannot stand both the work and fighting off the flies. Some men work their horses at night in an effort to eliminate the attacks, but this is too severe for the teams, as the flies have allowed them no rest during the day. Numerous instances of horses becoming frantic from irritation are recorded. These often result in runaways and their attendant damage. Animals that are not being worked sometimes are injured by running into barbed-wire fences in endeavoring to escape the flies.

Along the Gulf and Atlantic coasts, particularly in western Florida, this pest frequently becomes extremely annoying to men and livestock late in the summer and in the fall. The flies often attack people on the beaches so violently as to drive them to cover; and vacationists naturally leave the affected areas when such hordes of flies appear.

In the Corn Belt, where many cattle are fattened, the stablefly is a source of great loss. Feeders frequently find it necessary to put their animals on the market without proper finish because gains are impossible and loss in weight is common when the flies become numerous.

SUMMARY OF LIFE HISTORY

Like all other flies, this species has four stages in its life history—namely, the egg, larva, pupa, and adult.

The egg.—The eggs of this fly are elongate ovoid and of a creamy white color. They are about one twenty-fifth of an inch in length and under a magnifying glass show a distinct furrow along one side. When placed on any moist substance they hatch in from 1 to 3 days after being deposited. In hatching a small slit is made around one end of the groove, and the minute maggot crawls out. Figure 1 shows four eggs on a piece of straw.

FIGURE 1.—Eggs of the stablefly attached to a straw. Greatly enlarged.

The larva, or maggot.—When first hatched, the larvae, or maggots, are about one-twelfth of an inch in length and, being translucent, are not easily seen with the naked eye. Development takes place fairly rapidly when the proper food is available, and the growth is completed within 11 to 30 or more days. When full-grown the larvae (fig. 2) are pale yellow or nearly white and about four-fifths of an inch in length. They have the typical shape and action of most maggots of this group of flies. The hind end is large, and the body tapers to the head. When exposed to the light the maggot quickly disappears in the straw or other matter in which it is developing.

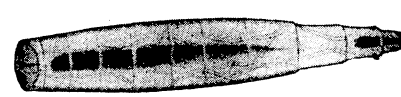

FIGURE 2.—The stablefly: Larva, or maggot. Greatly enlarged.

The pupa.—When the larvae are full-grown, they shorten and become thicker, and the skin contracts and hardens to form the case in

which the transformation to the adult is to take place. This puparium, or pupal case (fig. 3), is rather soft and yellowish at first but soon becomes harder and changes to reddish brown. It is elongate oval, slightly thicker toward the head end, and from one-sixth to one-fourth of an inch in length. During this stage the insect is completely dormant, the transformation from maggot to aduly fly going on within the puparium. This resting stage requires from 6 to 20 days, or in cool weather considerably longer.

FIGURE 3. — The stablefly: Pupa. Greatly enlarged.

The adult.—When the fly has completed its development within the puparium it pushes its head against the end until the shell splits open. Then it crawls out as an adult fly, but so different from the fly ordinarily seen that one would scarcely recognize it. The color is pale, and the head bulges out in front between the eyes. At this time the wings are only small wrinkled sacs. In a few minutes air is forced into the wings, and they unfold slowly, the fly becomes gradually darker in color, and its body becomes harder. Up to this time the beak is not visible, as it is bent downward between the legs. Soon it becomes almost black and is brought forward in its natural position so that the tip may be seen from above. When completely dried out, the adults show four rather distinct, dark, longitudinal markings on the thorax, as well as several dark spots on the abdomen. The male usually is slightly smaller than the female, the body of which measures from one-fourth to five-sixteenths of an inch in length. The adult, as seen from above, is shown in figure 4, and a side view of a female specimen engorged with blood is shown in figure 5.

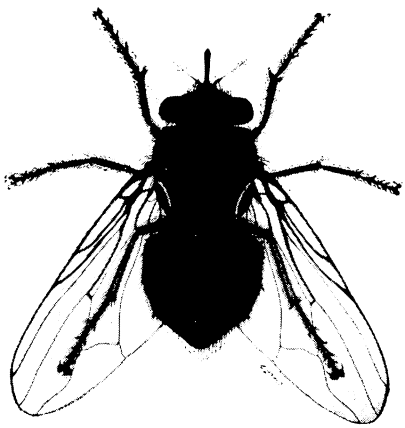

FIGURE 4.—The stablefly. Adult as seen from above. Greatly enlarged.

DEVELOPMENT AND HABITS

BREEDING PLACES

Horse manure has been considered the normal breeding medium for this pest. Investigations made during the outbreak in 1912 showed clearly, however, that the vast majority of the flies bred out in strawstacks, and investigations made around stables and barns indicate that while the fly breeds in pure horse manure it favors a mixture of this substance with straw. The fly was found to be breeding in much greater abundance in oat straw than in wheat straw. This appeared to be due to the softer stems and the greater amount

of leaves in the oat straw, which furnished better food and allowed the stacks to become more compact. Rice straw was found to furnish suitable breeding conditions, and there is little doubt that barley and rye straw often serve as food for the immature stages.

This fly has been found by Professor Iches to breed in Argentina in great numbers in the debris left after threshing flax. A careful examination of portions of alfalfa stacks which were moist and readily accessible to numbers of flies showed that they were not infested, nor were accumulations of weeds and bunches of grass in open fields. The insect occasionally may breed in broken-up masses of hay or dead grass, especially when these are permeated with liquids from manure, and corn husks in feeding pens have been found to harbor the maggots.

On some of the islands in the Great Lakes and along the Gulf and Atlantic coasts these flies are present in great numbers nearly every summer. It seems certain that they breed in accumulations of fermenting vegetation under such circumstances. The principal breeding place is probably in windrows of seaweed deposited at a favorable height above the water.

FIGURE 5.—The stablefly: Adult female engorged with blood, side view. Greatly enlarged.

The manure piles commonly found near stables where horses are kept furnish suitable breeding conditions. This is especially true in the early spring, when the warmth of the manure appears to be very attractive to the flies for egg laying. Cow-lot manure which has become broken up, especially when mixed with waste feed, is utilized as a breeding place; and so is silage, particularly when mixed with straw, as is often the case when the bottom of a silo is cleaned out. Experimentally, a few specimens have been reared from pure cow manure, but this substance seems to be unattractive to the adult and not favorable for the breeding of the larvae on account of its very compact texture.

The stablefly has never been found breeding in human excrement and does not frequent malodorous places, which are so attractive to the housefly; hence it is much less likely to carry typhoid and other germs which may be found in such places.

This insect develops somewhat more slowly than the housefly, and it is therefore more essential, in order that it may breed successfully, that the eggs be deposited in rather large accumulations of material. The larvae are sensitive to drought and soon succumb if the material in which they are developing is not kept rather moist.

HABITS OF THE ADULT

Both the male and female of this species feed on the blood of animals. They appear to discover their host mainly by sight and usually, especially on cattle, pass quickly to the lower portion of the legs, particularly on the outside, where the hair is somewhat shorter

than on the other parts of the animal and where they are less likely to be struck by the tail of the host. When flies are very abundant their attack is by no means confined to the legs, as both cattle and horses have been seen practically covered with flies on all parts of the body. They seldom remain on the host long without inserting the beak. Before blood is extracted they are easily disturbed and often move about several times before settling down for final engorgement. After the beak is well inserted and the blood begins to flow they usually become engorged in from 2 to 5 minutes. The insertion of the beak is accompanied by a rather severe, sharp pain. This accounts for much of the worriment caused to the host. After blood extraction has begun little or no pain is felt. During feeding the abdomen becomes greatly distended (fig. 5) and often of a distinctly reddish color. When satisfied, the fly withdraws its beak and flies rather sluggishly to some near-by object, where it rests while digesting its meal. When the proboscis is withdrawn a drop of blood usually exudes from the wound. Numerous small flies have been seen to frequent the blood which exudes in this way, and it is not improbable that the screwworm fly [4] may deposit its eggs on these spots and thus cause infestation of the host with its maggots.

During warm weather the blood is digested rapidly and the flies may feed again the same day. When the weather is cooler they usually require about a day for the digestion of the blood. After partaking of a meal the flies, during hot weather, ordinarily alight on the walls of buildings or on foliage of plants in shady situations. When the temperature is lower they remain in the sunlight, but in all cases they tend to avoid strong wind.

Adults frequently follow for considerable distances teams traversing roads and finally, when engorged, settle on near-by objects. Other teams which pass along the same highways are thus frequently attacked by flies which have completed the digestion of their previous meal, and this has given rise to the idea that the flies are breeding in weeds, grass, and hedges along the highways. This is also a means by which the flies invade territory beyond that in which they develop. Adults have been observed to travel many miles in the passenger coaches of railways. Few individuals are carried in this way, but doubtless the spread of the species is aided, and, what is more important, diseases might be spread in this way by infected flies.

Feeding may take place a number of times. Experimentally, individual flies have been induced to engorge as many as 14 times. Flies have been observed to partake of water and to feed to some extent on succulent fruit. They feed commonly on the moisture on fresh manure and on rotting straw. Although man is bitten by these flies occasionally, horses and cattle seem to be preferred as hosts. Dogs are also severely attacked, especially on the ears, which are often denuded of hair and made practically raw by the numerous bites.

REPRODUCTION

Mating of the flies takes place while they are not on hosts, and egg laying soon follows, provided the flies have fed a sufficient num-

[4] Known scientifically as *Cochliomyia americana* C. and P.

ber of times. It seems that at least three feedings on blood are necessary for the production of eggs. After the third meal is digested the flies seek suitable places for oviposition. When the weather is cool additional feedings are often necessary before eggs are produced. The adults appear to have a keen sense of smell and are able to detect moist straw and suitable manure very quickly. This is especially noticeable when a strawstack which is dry on the outside is opened up so as to expose the moist and rotting interior.

Very soon after a stack is opened flies are seen coming to the moist straw in numbers and beginning to deposit eggs. Usually they crawl into the loose straw, sometimes going to a depth of several inches. When laying eggs the fly greatly extends the ovipositor and uses it as an organ of touch in locating a suitable spot. The eggs are laid in irregular masses, although occasionally single ones are deposited. The female usually moves several times during oviposition so that each egg mass contains from a few to as many as 25 or more eggs. The greatest number of eggs which a stablefly has been observed to deposit before taking another meal of blood was 122. After all of the eggs have been deposited the female again seeks a host, and this feeding is again followed by egg laying. Three or more of such ovipositions commonly take place in this species. It is sometimes necessary, especially during cool weather, for a fly to become engorged twice before each oviposition following the first. The greatest number of eggs which a single female has been seen to deposit during her life is 632.

LENGTH OF LIFE OF THE ADULT

A knowledge of the length of life of the adult is important in determining its possibilities as a disease carrier and annoyer of animals. Individuals kept in small tubes without food or water during hot weather died within 2 days. When water and sugar sirup were supplied to flies in a screen cage about 1 foot square, one specimen out of a large number of males and females lived for 23 days. Individuals that had access to blood at frequent intervals lived 17 days, and a few specimens, among a considerable number which were kept in large cages with cattle and suitable material in which to deposit eggs lived for 29 days. During cool weather the length of life is still greater. Under more abnormal conditions other investigators have kept individuals alive more than 3 months.

THE LARVA AND ITS HABITS

The larvae, or maggots, begin feeding as soon as they hatch from the eggs and continue to do so throughout their growth. Portions of moist straw or other material in which they are breeding are torn off by their mandibles, which are located on the narrow or head end of the maggot. When very small, they frequently penetrate between the layers of moist stalks or leaves of grain in the strawstack. When larger, they often feed within the straws, and transformation to the resting state sometimes takes place in this protected situation.

The larval period lasts from 11 to 30 days, and during very cold weather probably considerably more than a month. The character

and abundance of food and the amount of moisture have an important influence on development, and larvae follow the moisture inward as the material in which they are developing becomes dry on the surface. Pupation occurs anywhere in the breeding material; it frequently happens, however, that the larvae, when in small masses of straw or manure, work downward as the material dries and pupate at the surface of the soil.

LIFE CYCLE

Complete development from the deposition of the egg to the emergence of the adult fly may take place in 19 days, or even in 14 days, according to some investigators. The developmental period, however, usually ranges from 21 to 25 days where conditions are favorable. Forty-three days is the longest period observed, although it is certain that in the late fall and during the winter months a much longer period is often necessary. The finding of full-grown larvae and pupae in straw during the latter part of March 1913, in northern Texas shows that development may require about 3 months, as these stages almost certainly developed from eggs deposited the previous December.

HIBERNATION

In the southern part of the United States there is no true hibernation of this insect. Adults have been found to emerge from their breeding material at various times during the winter when temperatures were not low. It is doubtful whether adults appearing under these conditions ever lay eggs. The individuals which pass the winter successfully hatch from eggs laid in the fall and continue development slowly during the winter, emerging in early spring when the temperatures are favorable for reproduction. In the northern part of the United States few flies emerge during the winter months, this period being passed normally in the larval and pupal stages.

AGRICULTURAL PRACTICES IN RELATION TO FLY ABUNDANCE

Certain agricultural practices favor greatly the development of the stablefly. As has been stated, this species breeds most commonly in straw and horse manure or in a mixture of these two substances. The custom of allowing the manure from the horse stable to accumulate just outside of the stable doors insures the presence of stableflies at all times when climatic conditions are suitable for breeding. Allowing barnyards, especially around dairies, to become knee deep in manure is also calculated to produce flies in abundance.

In the grain belt it is the practice of farmers to thresh the grain in the fields by means of self-stacking threshing machines. The individual stacks cover much ground, and the straw is very loosely piled. In many cases for convenience several stacks are formed in various parts of a field. When threshing is followed by heavy summer and fall rains this loosely piled straw is certain to form a breeding place for great numbers of flies. This is precisely what happened in 1905, 1912, 1926, and 1937, when serious outbreaks of the stablefly occurred. In many instances strawstacks are not protected from livestock. The animals soon scatter the straw and by adding manure still further

favor fly breeding. These strawstacks usually are allowed to remain throughout the fall and winter without attention. When the succeeding crop is planted the area occupied by the stacks is simply left uncultivated. In a few cases stacks are burned in the spring, but frequently they are left from year to year, and the new straw is added to the old stacks, destruction only taking place when the stacks become exceedingly large.

It will be seen that these practices not only encourage the breeding of the stablefly, but when the straw becomes sufficiently rotten and compact the housefly as well breeds in it in abundance. Throughout the grain belt a very considerable amount of valuable land is thus left untilled, and the full manurial value of the straw is lost. That the stacks serve some purpose as shelter and feed for livestock kept in the fields during the winter is the only legitimate reason for not scattering them or burning them in the late summer or fall.

NATURAL CONTROL

CLIMATIC EFFECT

The flies feed when the temperature is very high and the sun bright and hot as well as during cool and cloudy weather. They have been observed to attack animals during drizzling rain, and when somewhat protected by sheds and stables they often feed during a heavy rain. The lowest temperature at which flies have been observed to partake of blood was 55° F. When the temperature goes below 60° their desire to feed is less marked. Between 40° and 48° they lose their ability to fly, and complete inactivity occurs when the temperature ranges between 31° and 45°. This range of activity is due to variation in individual flies, to the rapidity of the decline or rise in temperature, and to the minimum temperature experienced by the individuals. No flies appear to be killed by a temperature not lower than 27°, and some at least are able to survive temperatures considerably below this point. All flies at Dallas, Tex., seem to have been killed when the temperature reached 8°. As has been stated, the flies always seek shady places during hot weather, but when the temperatures are lower they delight to dart about in the sun in a manner very similar to that of the housefly.

The maggots, or larvae, are very susceptible to drying. This is particularly true soon after they have hatched. Excessive moisture also is detrimental to their development, and flooding kills them in a few hours. They appear to be able to endure rather high temperatures when abundant moisture is at hand, although the heat produced in manure and strawstacks is often sufficient either to kill them or to drive them outward. No doubt the generation of heat within the breeding places stimulates the development of the immature stages during the fall and winter months. Light is detrimental to the development of the larvae. When placed in bright daylight, even though sheltered from the sun, larvae have never been known to complete development. These facts make it possible to destroy the pest in this stage of its life.

The pupae of the insect, being inactive and protected, are much less susceptible to all climatic extremes. They appear to be able to

withstand low temperatures and are not very susceptible to heat or drying, especially after the development of the fly has proceeded for some time.

PREDATORY ENEMIES

Hogs, as well as chickens and other poultry, are capable of destroying great numbers of the immature stages of the stablefly. They are attracted to the strawstacks and manure piles partly by the grain, and incidentally they destroy the maggots and pupae which they find. Several kinds of insects are important destroyers of these stages. Certain beetles devour them in considerable numbers. The adult flies fall prey to numerous enemies. Among the more important enemies of the adults are the large robber flies, which may be seen in great numbers around strawstacks, pouncing upon stableflies which are depositing eggs or resting upon straw. Wasps of several kinds capture the flies that are attacking stock or flying about. When filled with blood, the flies are comparatively sluggish and much more easily caught by these enemies, and spiders often devour them.

PARASITIES

Two species of small wasplike insects have been found to breed within the pupae of the stablefly. These insects deposit their eggs through the hard puparium, and instead of an adult stablefly the little parasite emerges. In some cases, where the immature stages of the fly were concentrated in great numbers, as many as 40 percent of the pupae were found to have been destroyed by these parasites. At least one of the parasites [5] has a wide distribution in this country.

ARTIFICIAL CONTROL

As is the case with most insects, the destruction of the stage which is actually doing the injury is most desired by those concerned. With this species, as with many others, this is very difficult, and some more easy way of securing the desired end must be determined. With the stablefly the natural point of attack is found in the immature stages; and there is every reason to believe that by properly caring for substances in which it breeds, the insect may be kept well under control.

PROTECTION OF LIVESTOCK FROM ATTACK OF THE STABLEFLY

When adult flies are present in great numbers it is necessary to devise some means of protection against them, especially since we know that every individual is capable of feeding a number of times before it dies. Most of the materials used with a view to repelling the flies from livestock have been found to be ineffective and, although some gave a measure of protection for a time, none had a lasting effect. In addition to the temporary value of these substances, in many cases injury was produced by their application, especially if persisted in often enough to keep the flies away. These facts emphasize the importance of taking steps to prevent fly breeding rather than depending on protection of the stock against the flies.

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[5] *Spalangia muscidarum* Richardson.

Work animals may be largely protected from the pest by means of coverings. One type of covering which has been found very effective and inexpensive consists of a blanket made of double thickness of burlap so arranged as completely to cover the back, sides, and neck of the animal (fig. 6). The legs also are then sometimes covered by means of old trousers slipped on over the feet and tied over the back. Leather nets or strips of leather attached to the bridle also aid in keeping the flies from the head. The ordinary fly net has been found to be of little value as it only tends to displace the flies temporarily and cause them to settle in places not covered by the net.

Many malodorous mixtures, particularly of an oily nature, have some value as repellents, but in preparing these care should be taken that they are not made too strong, particularly when animals are

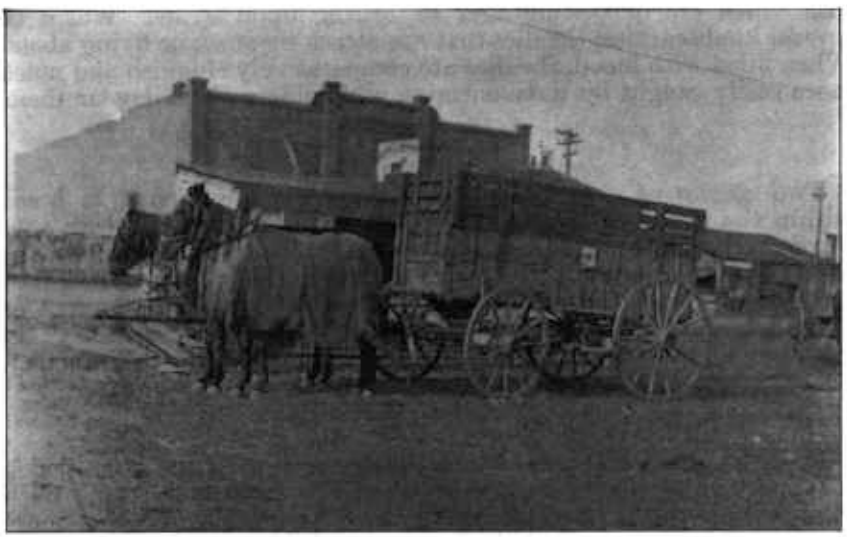

FIGURE 6.—Burlap covering used to protect horses from the stablefly.

being worked in the hot sun, as they are likely to cause overheating and often produce shedding of the hair. A mixture of fish oil (1 gallon), oil of pine tar (2 ounces), oil of pennyroyal (2 ounces), and kerosene (½ pint) was found to be fairly effective in keeping the flies off of livestock for a short time when applied lightly, but thoroughly, to the portions of animals not covered with blankets or nets. Kerosene extract of pyrethrum is a very good spray for killing the flies.

Completely darkened stables offer much protection from the flies, although the resulting lack of ventilation is objectionable. The thorough screening of all windows and doors is much more desirable. When screened barns are used, care should be taken to brush the flies from the animals, when they are about to enter, by means of nets over the doorway, or with sacks. The flies that gain entrance to the barn may be killed by spraying with kerosene-pyrethrum extract. After the animals have been driven into the barn, especially if the door is on the south side, numbers of stableflies often collect on the doorjamb and the side of the barn in the bright sunlight. In this situation

it is considerably easier to kill them by spraying than when they are on the animals.

Little can be done to protect range stock from the flies. On hog farms a freshly plowed trench offers considerable protection to the swine. The sides of the trench may be smeared with petroleum, which is rubbed off on the animals and acts as a repellent. The trench may be used also for protecting sheep, but the petroleum in their case is unnecessary.

TRAPPING THE FLIES

It is impossible successfully to capture adult flies by means of the traps ordinarily used for the housefly. A trap has been designed by C. F. Hodge, however, which may be utilized in capturing adults as they enter or leave barns. This trap (figs. 7, 8, 9) is undoubtedly very effective under certain conditions and has the advantage of catching not only the stablefly but also the housefly and other obnoxious species. In order to employ the trap for the stablefly, it should be built in a frame so as to fit closely in a window, preferably on the brightest side of the barn and close to the cows or horses kept within. Other windows should be darkened by hanging gunny sacks over them. This may be done so as not to interfere with ventilation, and the sacks, by flapping in the wind and darkening, both drive and cause flies to be attracted to the light-trap window.

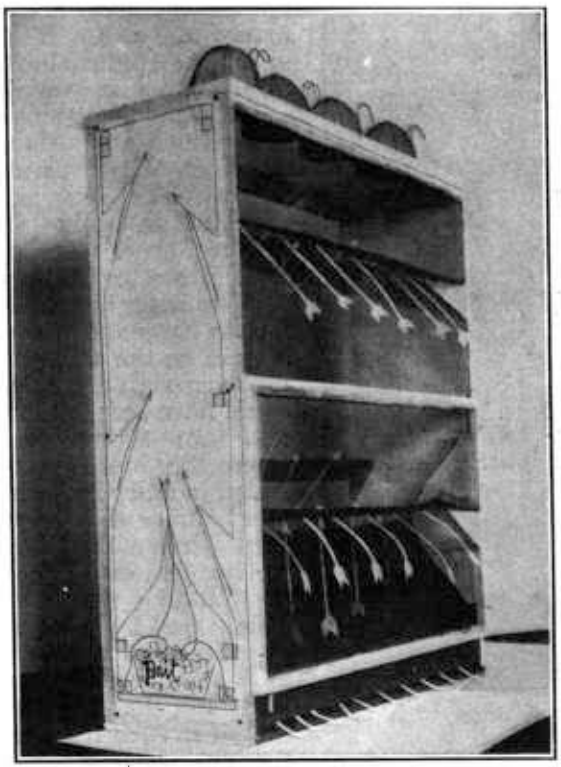

FIGURE 7.—The Hodge flytrap, showing where the flies enter. (Hodge.)

At the bottom of the trap a space about one-fourth of an inch wide running entirely across the window is left on both sides of the frame. This crack admits the flies beneath a roof or ridge of screen wire having holes large enough for flies to go through punched along its top at 2-inch intervals. To capture the houseflies, bait consisting of any material attractive to them is placed in pans beneath this ridge. The flies enter this space, ascend through the holes, and are unable to escape.

The sides of the trap, also, are made of ordinary screen wire bent inward and upward in two horizontal folds running across the window, one toward the bottom and one toward the top. The ends of the screen are then securely tacked and a series of small holes punched along the inner edge of each of the folds. The flies, in trying to go in and out through the window, crawl into the folds and enter the holes at the apex, but never escape, as on the inside the holes are along the projecting ridge. Professor Hodge states that a trap set in a window in a basement barn near a cow within caught nearly 5 quarts of flies from July 1 to November 1. The stablefly constituted 90 percent of these flies.

This trap is inexpensive and can be made by anyone with a box, or box lumber, and screen wire. It is especially well adapted to well-made barns where the flies do not have numerous places for entrance and exit. It is also more applicable to small barns in which animals are kept more or less constantly than to large dairy barns where the cows are brought in only at milking time. Under the latter conditions the flies enter the barns on the cows and many remain on the walls of the barn until after the cattle have been turned out. In some cases where flies are concentrated in dairy barns in this manner they have been driven out by forcing live steam into the building from the boilers used for sterilizing purposes. Where such arrangements are made the flies may be caught in such traps as the one described, as they are endeavoring to escape from the barn, which should first be tightly closed.

FIGURE 8.—The Hodge flytrap fitted to a barn window. (Hodge.)

If such barns are tightly closed, as above, during the light part of each day and the windows without traps darkened, practically all the flies will "catch themselves" in trying to escape through the trap-window or windows.

Electric grids placed in windows have also been found useful in killing the flies as they attempt to enter or leave the barn.

DESTRUCTION OF IMMATURE STAGES AND PREVENTION OF BREEDING

Since strawstacks have been found to be the principal breeding places of this insect in the grain belt, the proper care of the straw is by far the most important step in control. When the straw is to be kept for protection and food for livestock, it should be stacked with

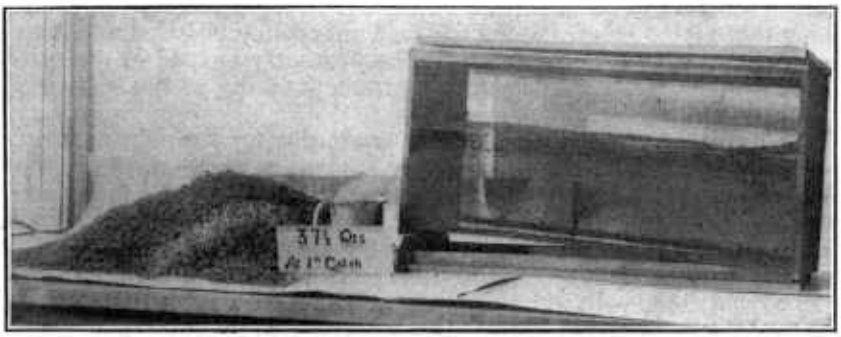

FIGURE 9.—Pile of flies caught in a Hodge flytrap. (Hodge.)

more than ordinary care. The sides of the stack should be made nearly vertical, and it should be rounded up well on top, the better to shed the rain. With blower stackers a very satisfactory stack can be put up by controlling the blower and keeping one or two men on the stack. This method is shown in figure 10. After the stack is complete it is advisable to clean up around its base and to scatter or burn the loose straw and chaff.

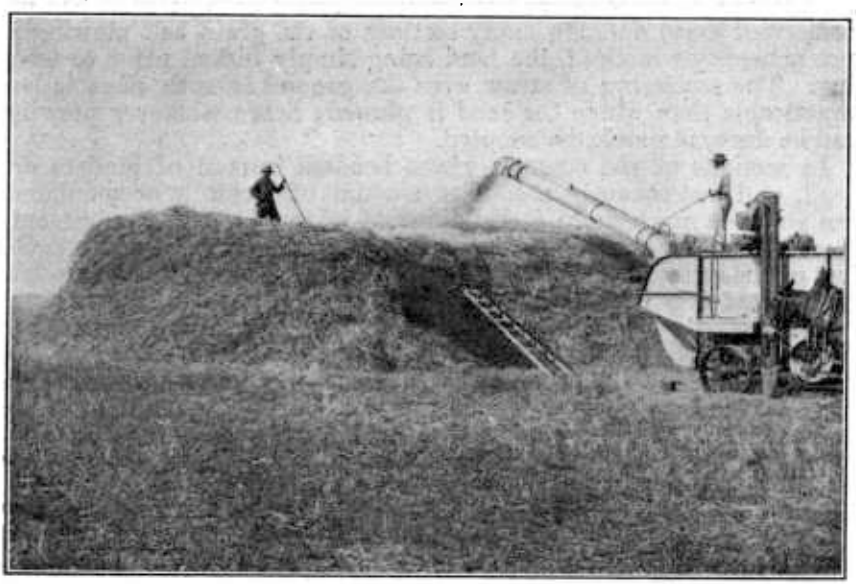

FIGURE 10.—Stacking straw to prevent stablefly breeding.

So far as possible, all straw that is not required for winter feed for stock should be disposed of immediately by scattering it over the land soon after threshing and subsequently plowing it under, or by burning the stacks. The plowing under of the straw that cannot be used for feed is the most advisable procedure in regions where the moisture is sufficient to cause it to rot rapidly. Oat straw is most generally used for feeding purposes, and this straw forms the principal breeding ground for flies. It is therefore important in regions where rainfall is heavy that all oat straw needed for feed or bedding be baled and stored under cover and that the remainder be promptly burned or scattered. In the drier sections of the country proper stacking of the straw may be depended upon for its preservation.

All strawstacks not consumed by stock during the winter should be promptly disposed of in the early spring, as these stacks furnish flies continuously during spring and summer. Often the flies reared in such situations are abundant enough to cause great annoyance to livestock during the early spring and by multiplying throughout the summer produce an almost incredible number by fall.

The conditions—that is, the heavy rainfall on the freshly threshed straw—which have produced most of the severe outbreaks render the straw largely unfit for feed for livestock, as the stacks in many cases are wet through and soon become heated and rotten. In such instances, where the flies are already breeding in these stacks, their immediate destruction by burning or scattering is necessary to relieve the conditions. When stacks are scattered the work should be done thoroughly, so as to expose the straw completely to the influence of the sun, wind, and light. By this procedure practically all of the larvae and many of the pupae are destroyed. Straw spreaders which are said to give satisfaction are on the market.

It is best to plow under the scattered straw soon after it has become well dried out. In many sections of the grain belt plowing is not generally practiced, the land being simply disked prior to seeding. The scattering of straw over the ground in such cases is less practicable than where the land is plowed; hence wherever plowing can be done, it should be adopted.

In sections of the country where headers instead of binders are used, and consequently a smaller amount of straw is accumulated, the straw is much more easily disposed of by the methods just outlined. The use of combined harvesters and threshers solves the problem of the strawstack, for by this method the straw and chaff are left distributed over the fields.

The use of poisons or other substances, with a view of destroying immature flies in strawstacks, is neither practicable nor advisable. Enormous quantities of these materials would be required to permeate the straw to kill the larvae, and, even though they were destroyed, the straw would be rendered dangerous to livestock.

Although straw is the principal breeding place for stableflies within the grain belt, there is no doubt that thousands of them develop in manure piles. Moreover, such material is utilized extensively as a breeding place for the housefly and horn fly. Hence the proper care of all sorts of animal refuse is essential for successfully

combating the pest. Manure should be hauled out and scattered at regular times, preferably every 3 days, as is recommended for the control of the housefly, and any accumulations of straw or hay, especially adjacent to stables, should be disposed of, as these are often utilized by the stablefly for breeding when larger accumulations of horse manure and straw are not available.

Manure boxes provided with a trap on top to catch the flies which breed out (fig. 11) prove very satisfactory for farms with a few head of stock. The box should be as nearly flyproof as possible and the manure put into it at least every 4 days so as to catch the houseflies as well as the stableflies.

Manure pits properly screened and with flytraps provided are adaptable to use on dairy farms, and the maggot trap described in

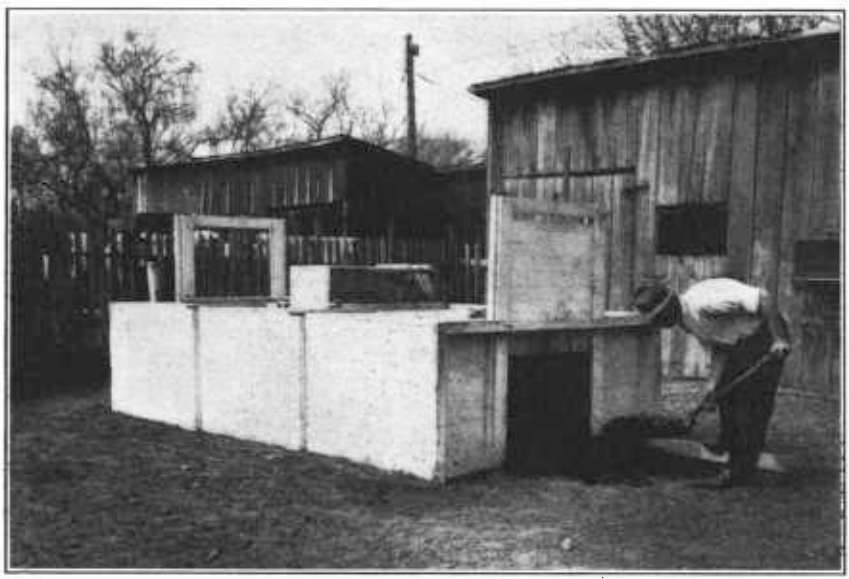

FIGURE 11.—Manure box with flytrap attached.

Farmers' Bulletin 1408 will destroy many stablefly maggots as well as those of the housefly.

A large percentage of stablefly larvae as well as larvae of the housefly may be destroyed in manure by treating it with hellebore or borax. The former is used by soaking one-half pound of hellebore in 10 gallons of water for 24 hours and sprinkling this quantity over each 8 bushels of manure. The borax, used in powdered form at the rate of 1 pound to each 16 cubic feet of manure, is scattered over the pile and sprinkled with water. Neither of these substances will injure the fertilizing value of the manure if used in the quantities indicated and if not over 15 tons of the treated manure is applied per acre.

The need of properly caring for stable refuse is still further emphasized by the fact that there are far more manure piles than straw-

stacks. Furthermore, the stable manure is usually in close proximity to the habitations of man and thus furnishes flies, which have freer access to man, with consequent greater potentiality as disseminators of human diseases.

MEDICATED SALT VALUELESS

Certain medicated salts, most of which contain sulfur and common salt, have been placed on the market. The claim is made that their use in lieu of common salt will protect stock from flies. Such materials are entirely valueless against flies.

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